SOA tracers in a background site in the Eastern Mediterranean: exploring formation pathways.

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Primary organic aerosol (POA) consists of directly emitted organic compounds, of biogenic (i.e., isoprene, monoterpenes, sesquiterpenes) or anthropogenic (i.e., benzene, naphthalene) origin, referred to as Volatile Organic Compounds (VOCs). POA undergoes numerous transformation processes and forms the Secondary Organic Aerosol (SOA), containing carboxylic acids, alcohols, carbonyls, organosulfate and organonitrate esters. It is important to elucidate the mechanisms of SOA formation and its influence on atmospheric processes. Furthermore, the chemical composition of the SOA must be determined to assess the effect on human health and the environment and define its toxicity.

A one-year-long field study has been conducted at an urban site of Nicosia, Cyprus (NICTRA) to outline the background levels of 118 SOA compounds in the Eastern Mediterranean region. Nearly 200 PM2.5 and PM1 samples have been analyzed for the determination of 92 organosulfates (OS) and organonitrates (ON) (method A) and 26 organic acids (OA) (method B) respectively. Results show statistically significant ($p<0.05$) differences between the distribution of SOA compounds in PM2.5 and PM1 particles. PM2.5 show higher SOA yields. For the organosulfate load of both PM clusters, lactic acid sulfate (LAS) and glycolic acid sulfate (GAS) are found to be the most abundant SOA, believed to derive from various sources and to associate with isoprene's transformation mechanisms, followed by OS with m/z 211, 213 and 215, generated from the isoprene epoxydiols oxidation mechanisms. Among the organic acids, azelaic acid exhibits the highest concentration in PM1 particles, whereas in PM2.5 particles, *β*-caryophyllinic acid is the most abundant. Statistical analysis tools have been applied to investigate correlations between the compounds' spatiotemporal distributions, indicative of possible common primary sources. Principal Component Analysis showed strong correlation between the majority of isoprene-OS and glycolic acid and lactic acid sulfate suggesting Isoprene as a common precursor VOC. The data were cross-examined with conventional pollutants' distributions to examine secondary formation pathways. In both PM clusters, a strong correlation is found between monoterpene-derived OS and NO_x levels (R^2=0.83 for PM1 and R^2=0.86 for PM2.5). Also, there is a strong correlation between SO_2 concentrations and ON levels (R^2=0.96 and R^2=0.96 for PM1 and PM2.5 respectively). On the other hand, GAS, LAS and isoprene-derived OS correlate with O_3 levels, which makes ozone the primary oxidant for their formation.

References:
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